Yakama Nation Environmental Management Program Sustainable Agriculture; BMP's for water quality

Yakama Nation Environmental Management Program

Nonpoint Pollution Source Management on the Yakama Reservation, an Ongoing Effort

Nonpoint Source Pollution

- Nonpoint Source pollution may be thought of as water pollution that originates across the landscape as opposed to a point source such as a piped discharge from a waste water treatment plant.
- Nonpoint can include: sediments, synthetic chemicals, nutrients, potentially pathogenic organisms and a variety of other substances.
- Typically NPS is associated with surface runoff across a managed landscape or inflow of polluted ground water into surface water. E.g's:
  - Surface runoff crossing a farm field and entering a surface water body
  - Ground water flowing through a drain field of an improperly functioning septic system and thence into a stream.

Tracking Nonpoint Source

Nonpoint can be chronic, intermittent, or cyclic, E.g's:

- Chronic:
  - ground water flowing through an improperly sited or maintained septic system
- Intermittent:
  - surface runoff associated with precipitation events flowing across landscape and picking up pollutants, thence flowing into stream
- Cyclic:
  - suspended sediment entering streams from **irrigation return flows** during the **irrigation season**

Yakima River Sediment Reduction

Which irrigation BMP's affect water Quality in the Yakima River?

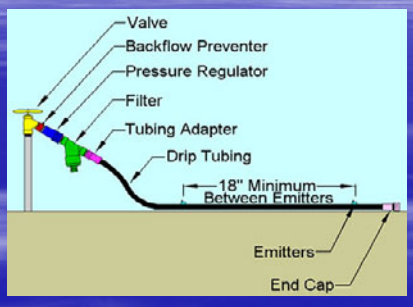
- Improved water distribution efficiency
  - Delivery system, canals, ditches and drains
    - Canals engineered for better head regulation
    - Ditches were piped
    - Return flows to drains were piped
      - Roger Henderson will be providing WIP update at noon
  - Field irrigation practices:
    - Sprinklers
    - Drip systems
    - Improved Surface irrigation

Sprinkler Irrigation

Sprinklers

- Benefits:
  - Greatly increase uniformity of water application
  - Generally a good method to minimize pollution
    - surface runoff avoidable
    - Ground water pollution avoidable
- Drawbacks :
  - require power to operate, unless gravity driven,
  - can be very expensive,
  - can pollute ground and surface water if too much water applied,
  - water lost to evapo-transpiration.

Very Simple Drip System



Filter and pump apparatus for small scale Subsurface drip irrigation of rotationally grazed goat pasture in Texas, 2 acre site

Installing Drip tape for alfalfa seed crop. NPS control as good as feasible, although some wind drift into water bodies may occur, or very slight leaching from natural precipitation events.

Drip Systems

- Advantages:
  - Can greatly improve water use efficiency
  - Provide opportunity for chemigation.
  - Surface runoff minimal to nonexistent
  - Buried drip for alfalfa allows simultaneous harvest and irrigation
  - Generally improved yields and quality
- Disadvantages :
  - potential ground water pollution,
  - potential wind erosion,
  - expense minimizes use on annual crops other than vegetables.
  - Rodent damage to systems

Surface Irrigation

Surface Irrigation: Flood, Rill or Furrow

- oldest and most extensive type of irrigation
- In Yakima River, sediment in surface irrigation return flows is significant nonpoint source pollutant
  - Sediment impedes drainage necessary to productive agriculture.
  - Eroded sediment = loss of fertility.
- Little research on improved methods of surface irrigation for decreasing sediment
  - Straw furrow mulch
  - Surge irrigation
  - Pump back systems
  - Runoff retention basins
  - PAM

Surface Irrigation Tailwater; note eroded soil

A short while ago this soil was at the head of the field

10-20 tons of soil/day eroded from a farm field to irrigation drain!

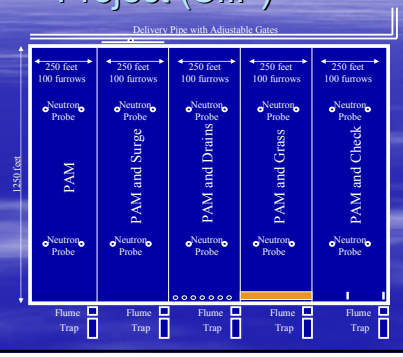
An irreplaceable resource becomes a pollutant; one of the potential sources of Columbia River pollution.

Sediment Reduction Effort, Yakama Reservation

A Team Effort focused on:

- surface irrigation improvement (SIIP).
- Drain Cleaning (WIP interaction).
- Drain water for wetland restoration .

Surface Irrigation Improvement Project (SIIP)



The Power of PAM

Check Dams

Surge Irrigation

Surface Drains

Grass Filter Strips

Hourly water samples taken throughout 48 hour irrigation; grass is clear winner

Continuing with SIIP Research

- Project ran out of grant money, but more research is needed
- Current CWA 106 grant continuing project as education and outreach. To date donations of grass seed, mulch, equipment, labor and land have helped keep the fledgling second phase of the project going

Preparing to sow seed

Sowing the Seed

Mulching

Grass filter strip planted first week in April-2004; lightly mulched. Photographed early Summer

Matua Prairie Grass during late Summer after Spring planting; good stand establishment.

Matua Prairie Grass dropping seed within the first Summer after early Spring Planting.

Italian Ryegrass; fast stand establishment but short-lived.

Filter Strip in Satus Area,

First Year Results

- Difficult to determine if the various species will perform differently in different soils; first year is too soon to determine if there are differences in:
  - erosion controlling capacity.
  - species persistence (although "Garrison" Creeping Foxtail did not successfully establish)

Stand Establishment

Hand seeding into Winter wheat appears to be a viable practice

Seeding Methods

- Drilling may facilitate stand establishment,
  - Note that South Yakima Conservation District has a no-till drill available for use.
- Broadcasting followed by shallow soil incorporation (Cultipacker) worked well.
- Light straw mulch appears beneficial

What to plant

- Recommend species to cover varying site conditions:
  - Use improved varieties of Orchardgrass, Tall Fescue, Italian Ryegrass, in a mix. Perennial Ryegrass may work just as well in a mix.
    - Species are sold locally as pasture mix for irrigation
  - Matua appears suitable for single species planting.
  - Possibly "Garrison" Creeping Foxtail for Fall Plantings; needs more research.

Weed Control

- Weed control through machine powered herbicide application is difficult in tail water areas because of constant wetness,
- Spot spraying with a hand sprayer may be feasible, but precautions must be taken to minimize entry of herbicide into the tail water.
- Don't mow while the soil is saturated
- During stand establishment keep equipment off the grass or weeds will encroach.

Updates on Filter Strip Project: planted in March, 2006. The Ditch on downstream end allows for additional erosion. It would be best if the entire filter strip was engineered as a grassed waterway

Note that missing one furrow with PAM application will contribute significant erosion

Filter strip captures a tremendous amount of sediment in front of Agnes. Contrast this situation with the previous slide.

Filter Strip captures sediment, but erosion still occurs in downstream ditch . We will try to address this by: 1) planting wet soil plants in the ditch and 2)installing small gravel check dams to slow velocity and capture sediment.

Sediment Basin after Grass filter strip. Note that placing a ditch at the downstream end of the filter strip still causes erosion.

Sediment, nutrients, possibly pesticides and herbicides entering Yakima River on June 20 2006. In spite of improvements, we still have work to do.

Next steps: mulches (living and killed) grown on-site for erosion control and nutrient management (Birdsfoot Trefoil , a perennial legume, shown here)

Kura Clover as living mulch in corn. This plant offers potential for less application of Nitrogen and interspersing pasture into the crop rotation for soil building of organic matter

Crimp-roller for killing annual grain crops for mulch. This is Organic production; no herbicide is used

Crimp-roller in front of tractor; seed drill in the rear. Mulch and plant in one pass, this is an example of organic agriculture high technology that saves energy and prevents pollution.

On-site crop grown for killed mulch even applicable to small garden-scale production

Intensive Rotational Grazing, with Irrigation, Excellent BMP for NPS control

Reduced herbicide use, reduction in fire fuels, = reduction in NPS

1200 # of heart healthy beef per acre with no erosion, no runoff.

Benefits

- excellent NPS control, sediment controlled, *E. coli in manure* don't move much, so don't enter surface water and can't compete below ground, so leaching is unlikely.
- and builds soil fertility, (crumb structure, entrapment of leachable Nitrogen, gradually releases Phosphorus, increases amount of P available to plant roots. Most nutrients recycled through the grazing process
- Proper grazing encourages tillering and strangely enough "cow nose exudates" stimulate growth of grazed plant, hence resulting vegetative growth, as opposed to plant maturation, increases organic matter through root death and regeneration
- Provides a sustainable means of building fertility for following harvested crops. "Ley Crop Farming"
- Crop residue or even early growth can also be grazed, or used as bedding for making compost E.g. grazing in grape vineyards, orchards, (livestock will clean up fallen leaves as well as pasture plants, corn stalks, wheat, as emergent green growth and/or stubble, straw can be treated with ammonia for improved digestibility, or used as bedding.
- Provides excellent use for off-season crops such as Triticale, Brassicas, Winter Peas, Faba Beans and other "Green Manure Crops", which in turn results in less erosion and entrapment in organic matter of Nitrogen leached below the summer crop root zone. (actual increases in slow release N in top foot of soil are being documented.)
- Lessened energy requirements as opposed to continuous crop production (fewer trips for tillage.

Costs/Risks

- Requires buying or leasing livestock
- Parasite/disease control can be problematic
- Potential for disease vectors to humans and vice-versa
- Fencing can be expensive (corn doesn't beak the fence and run away.)
- Requires stock sense and off-season labor
- Requires intensive forage management
- Some potential for wet season runoff
- Winter stock water and shelter can be problematic
- Markets can swing widely

Other YN DNR Nonpoint Source Control Efforts

- Water Resources, Shenando Creek Project

Figure 4. Culvert and road fill at site X2 removed. Channel stabilized with buried rock weirs in foreground and background of photo.

Figure 3. Site "X2" old culvert with 5 foot perched outlet. This culvert and approximately 400 cubic yards of road fill was removed from the floodplain. The channel was then stabilized using rock weirs, large woody debris placement, and reconnection of a historic side channel.

Close up of boulder weirs for grade control. Used appropriately it's a BMP for sediment, temperature control and a means to restore flood plain connectivity.

Figure 2. Rock weir grade control structure above culvert at site "X1". Orientation, elevation, angle, shape, and dimensions are carefully engineered to control streambed grade, flow direction, and protect erodible banks.

What legacy do you wish to leave?